Nephron-Sparing Surgery for Renal Cell Carcinoma

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Nephron-sparing surgery has become an established surgical treatment for patients with renal cell carcinoma (RCC), particularly in situations in which preservation of renal parenchyma is critical. However, due to the fear of local renal fossa recurrence with nephron-sparing surgery, radical nephrectomy has historically been the treatment of choice for patients with unilateral RCC and a normal contralateral kidney. Recently, increased incidence of low-stage, localized, solitary RCC has led to renewed interest in partial nephrectomy. With excellent disease-specific survival and recurrence rates comparable to that achieved with radical nephrectomy, nephron-sparing surgery can be confidently utilized in treating patients with stage T1 RCC lesions (<7 cm) and a normal contralateral kidney. The utility of nephron-sparing surgery in the context of adjunctive systemic immunotherapy remains to be explored. [Rev Urol. 1999;1(4):216-225]

Key words: Cancer, renal • Tumor • Computed tomography (CT) • UItrasonography • Surgery, urologic

Nephron-sparing surgery is an accepted treatment modality for renal cell carcinoma (RCC) in certain situations. In 1950, Vermooten first suggested that localized RCC could successfully be excised while leaving a surrounding area of normal renal parenchyma.[1] Since then, nephron-sparing surgery has been utilized in treating patients with RCC in which functioning renal parenchyma must be preserved. With the advent of more sensitive imaging modalities and improved surgical techniques, partial nephrectomy has been used for new, more expanded indications, leading to substantial increases in its utilization (Fig. 1). We reviewed the literature as well as our own experience with nephron-sparing surgery to evaluate its utility in this era of expanded indication.

Indications for Nephron-Sparing Surgery

Historically, nephron-sparing surgery has been the accepted mode of treatment in cases in which performing a radical nephrectomy would render the patient anephric and require subsequent dialysis.[2] Such indications include patients with

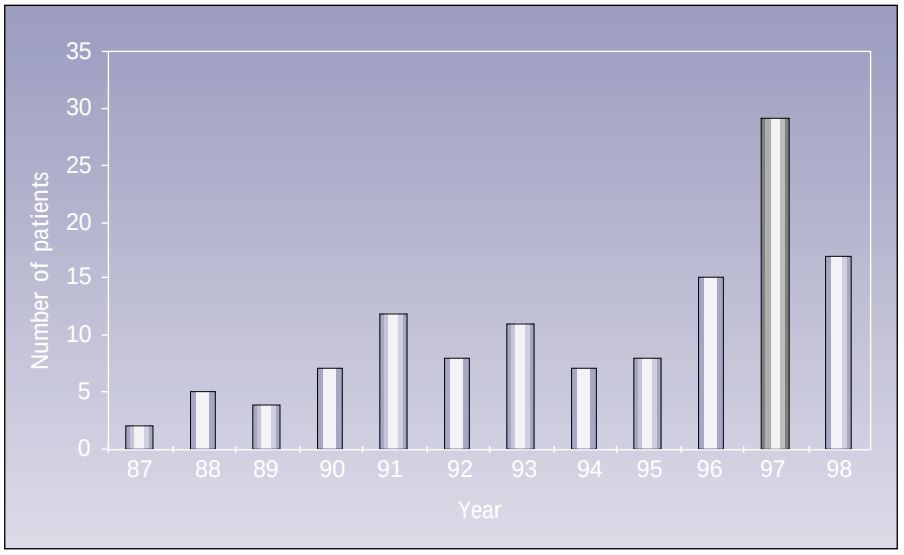

Figure 1. Numbers of patients who had a partial nephrectomy over the period 1987 to 1997: UCLA experience.

only a solitary functioning kidney secondary to unilateral renal agenesis, prior removal of a kidney, or malfunction of a kidney due to a benign disease process. Another such indication is seen in patients with bilateral RCC in whom bilateral radical nephrectomy would otherwise be required. Also, partial nephrectomy has been historically indicated in patients with unilateral RCC and a normal contralateral kidney, if the contralateral kidney is at risk for dysfunction in the future due to calculous disease, chronic pyelonephritis, renal artery stenosis, ureteral reflux, or systemic disease such as diabetes and nephrosclerosis.

Recently, the improved sensitivity of computed tomography (CT) and ultrasound has led to the increased incidence of incidentally diagnosed (Fig. 2), small, low stage RCC lesions.[3,4] Usually well localized and easily amenable to partial nephrectomy, these cases have created a controversy of whether nephron-sparing surgery is indicated when the patient has a normal functioning contralateral kidney. Engen and Herr published the first successfully performed partial nephrectomy for such an indication in 1981.[5] Since then, several studies have also demonstrated the successful use of partial nephrectomy for this indication. At UCLA, as in many other centers, the use of nephron-sparing surgery has greatly increased, specifically for patients with unilateral RCC and a normal contralateral kidney (Fig. 3). However, despite very encouraging results (discussed later in this review) obtained with partial nephrectomy in treating patients with this indication, fear of renal fossa recurrence and subsequent metastasis has led radical nephrectomy to remain as the gold standard of treatment for this indication ever since the Robson landmark study in 1969.[6]

Figure 2. CT scan revealing incidental finding of right renal mass.

Operative Considerations

Preoperative evaluation of patients with RCC should include assessment of the location and extent of the local tumor as well as the presence of any local or distant metastasis. Aside from standard imaging modalities, such as magnetic resonance imaging (MRI) and CT, several other studies must be performed to both determine the extent of tumor spread as well as assist the surgeon in taking the best approach to removing the tumor. Renal arteriography depicts the intrarenal vasculature and, thus, allows for a surgical approach that results in the least blood loss and destruction of adjoining renal parenchyma. For patients with large or centrally located tumors, selective renal venography should also be per-

formed to determine the presence of intrarenal venous thrombosis, a condition consistent with an advanced RCC stage and a more complex surgical excision. Preoperative hydration and mannitol administration are also imperative to ensure optimal renal perfusion at the time of operation.[2]

The various surgical approaches to partial nephrectomy have previously been described in detail. The general approach involves an extraperitoneal flank incision through the 11th and 12th ribs. The kidney is mobilized within Gerota's fascia while leaving the perirenal fat around the tumor intact.[2] Recently, intraoperative sonography has served as a useful adjunct in nephron-sparing surgery by helping to guide the surgical approach and excision of the tumor. Intraoperative ultrasound can provide a critical view of the extent of the tumor as well as the relationship of the tumor to renal vessels and other critical adjacent structures.[7] This intraoperative imaging modality is particularly useful in cases of deep intrarenal lesions that are nonpalpable and visually imperceptible during surgery. Ultrasonography can help delineate a surgical plane between the tumor edge and crucial hilar structures to facilitate excision. Also, in cases of large tumors invading the hilum, the surgeon may switch intraoperatively to more aggressive measures, such as radical nephrectomy, if ultrasonography displays critical involvement by the tumor that preoperative CT failed to clearly demonstrate.

Once the extent of the tumor has been delineated, several surgical techniques can be employed, depending on the tumor characteristics (Fig. 4a-c). Tumors confined to the upper or lower poles of the kidney are generally excised by means of a polar segmental nephrectomy. A transverse resection is employed for large tumors extending throughout the upper or lower pole of the kidney. For tumors not located in either the upper or lower poles of the kidney, a wedge resection is employed. Regardless of the surgical technique, the common principles of a 1 cm tumor-free margin, early vascular control, proper hemostasis, closure of the collecting system, and avoidance of renal ischemia should be followed.[2]

Once the tumor is excised, the control of hemorrhage becomes imperative. Given the increased complexity of nephron-sparing surgery, intraoperative and postoperative bleeding is a common complication. Hence, the control of bleeding is an integral aspect of the surgical procedure. The basic means of controlling severe bleeding requires clamping the renal artery temporarily while the source of bleeding is controlled. If such measures are anticipated for a prolonged period, surface cooling of the kidney with ice slush and mannitol infusion can provide safe ischemia and help avoid permanent ischemic injury to the kidney. Other methods of hemostasis found to be effective include ultrasonic aspiration, laser photocoagulation, microwave coagulation, and fibrin glue.[8-11]

Aside from this in situ approach to nephron-sparing surgery, some physicians support an extracorporeal approach, particularly for RCC tumors requiring very complex excision. Such

Table 1
Complications of Nephron-Sparing Surgery (UCLA)

Complication	No. (%)
Hemorrhage	3 (2%)
Urinary fistula	2 (1.4%)
Myocardial infarction	2 (1.4%)
Pneumonia	1 (0.7%)
Total	8 (5.5%)

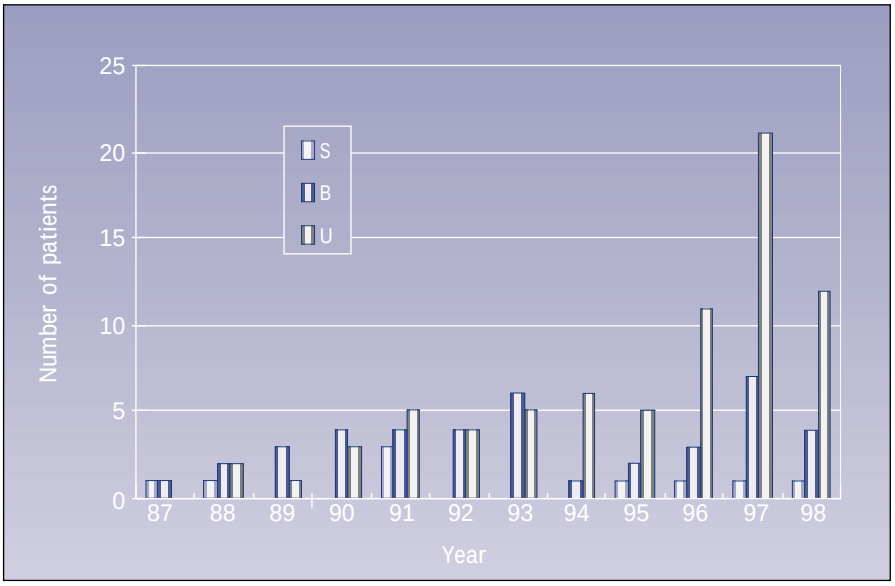

Figure 3. Numbers of patients with solitary/bilateral/unilateral renal tumors and a normal contralateral kidney who underwent partial nephrectomy from 1987 to 1997: UCLA experience. S, solitary renal tumor; B, bilateral renal tumor; U, unilateral renal tumor with normal contralateral kidney.

Figure 4. Before wedge resection of renal tumor (a); flap of fatty tissue to cover renal defect (b); gross pathology after excision of renal tumor (c).

a procedure involves complete nephrectomy, tumor excision and renal repair, and subsequent autotransplantation of the kidney. This procedure is beneficial in cases of large RCC lesions invading the hilum or in cases with concomitant renal artery disease, because it provides better access for the surgeon. However, the procedure suffers from drawbacks such as longer operative time and the increased risk of postoperative renal failure.[12]

Clinical Results of Nephron-Sparing Surgery

Surgical Complications. Given the technically challenging nature of nephron-sparing surgery, some substantial complications have been associated with this procedure. Two recent studies, by Campbell and colleagues (1994)[13] and Polascik and associates (1995),[14] reported complication rates of 30.1% and 50%, respectively. Both studies attributed the majority of complications to urinary fistulas, noted in 15.2% and 8.9% of cases, respectively. Factors predisposing to the development of urinary fistulas include tumor size >4 cm, the need for major reconstruction of the collecting system, and ex-vivo surgery. Other complications determined by these studies included acute renal failure, hemorrhage, infection, adrenal insufficiency, arterial and venous thrombosis, and ureteral obstruction. Of all the complications cited by Campbell, only 3.1% required repeat open surgery, and 2.9% resulted in adverse clinical outcomes. Both studies claimed that the incidence of complications was significantly less for procedures performed after 1988 (22% vs 37% noted in Campbell).[13] The studies attributed this finding to an increase of incidentally discovered tumors during this period leading to less complicated surgical procedures. A more recent study evaluating partial nephrectomies performed after 1988 demonstrated a complication rate of 27%, with increased creatinine, urinary fistula, and hemorrhage representing the top 3 complications.[15]

At UCLA between 1980 and 1997, we had a complication rate for partial nephrectomy of 5.5%. Of note, the majority of the surgeries performed during this period were undertaken after 1987. In our experience, the most common complication was hemorrhage requiring reoperation, occurring in 2% of cases. Other complications included urinary fistula (1.4%) requiring insertion of a stent, myocardial infarction (1.4%), and pneumonia (0.7%) (Table 1).

Results of Nephron-Sparing Surgery. Partial nephrectomy has been

Table 2
Results of Nephron-Sparing Surgery for Renal Cell Carcinoma

Reference	No. patients	Disease-specific survival (%)	Follow-up	Local tumor recurrence (%)
Novick et al	100	84	5 yrs	9
Morgan, Zincke	104	88.9	5 yrs	6
Steinbach et al	106	93	4.5 yrs	2
Licht et al	216	87	3-4 yrs	4.2
UCLA	146	100	5 yrs	2.7

demonstrated to yield excellent long-term cancer-free survival for patients with localized RCC. Early studies by Grabstald (1968)[16] and Schiff (1979)[17] demonstrated cancer-specific survival rates of 77% and 78%, respectively. These outcomes resembled those described by Robson in relation to radical nephrectomy.[6] More recently, several large studies (Table 2) have also demonstrated the efficacy of partial nephrectomy in treating patients with local RCC, yielding cancer-specific survival rates ranging from 84% to 93%.[18-21] In addition, another study by Zincke and colleagues[5] also compared the outcomes achieved through partial nephrectomy with those attained through radical nephrectomy and found fairly equivalent survival rates of 87% and 93%, respectively.

The major disadvantage to partial nephrectomy has been the increased theoretical risk of local renal fossa recurrence. Historically observed in 2% to 9% of cases, this recurrence has been postulated to occur secondary to either incomplete surgical resection or the presence of undetected microscopic RCC in the remaining kidney following tumor resection.[19-22] Studies have also demonstrated that such recurrence is found more often in larger tumors (6.7%) than in smaller, incidentally detected lesions (1.1%).[21]

Our experience supports these very encouraging results with nephron-sparing surgery. Partial nephrectomy performed at UCLA between 1980 and 1997 yielded an overall cancer-specific survival rate of 91%. A significantly higher survival rate of 98% was attained between 1988 and 1997, which we attribute to a higher incidence of incidentally detected, early-stage lesions secondary to the advent of better ultrasound and CT imaging modalities.

Analysis of these outcomes by clinical stage demonstrated that the success of partial nephrectomy in treating RCC was limited to T1 lesions according to the 1997 TNM staging criteria (Table 3).[22-24] When used to treat patients with T1 RCC, partial nephrectomy resulted in survival rates (100%) that were not significantly different than those obtained with radical nephrectomy (97.5%). However, the cancer-specific survival rate for nephron-sparing surgery in T2 RCC disease was 66%, which was significantly lower than the 91.4% achieved with radical nephrectomy for equivalently staged lesions.

Our experience also echoed past studies in terms of recurrence rates. Yielding a local recurrence rate of 3%, partial nephrectomies performed in our series did not result in a greater extent of recurrence than radical nephrectomies that resulted in a 2.4% recurrence rate. These data demonstrate the efficacy of partial nephrectomy in treating patients with early stage (T1), localized RCC lesions while allaying the predominant fear of recurrence that has historically limited the use of nephron-sparing surgery solely to situations in which preservation of renal parenchyma is a necessity.

Management of RCC With Coexistent Renal Artery Disease The management of RCC can sometimes be severely complicated by the presence of coexistent renal artery disease. If renal artery disease is present in the same kidney as the RCC, both diseases can simultaneously be remedied by means of a radical nephrectomy performed on the affected kidney.[25] However, when a patient presents with a solitary kidney with RCC and renal artery disease, bilateral RCC affected by renal artery disease, unilateral RCC and contralateral renal artery disease, or unilateral RCC with bilateral renal artery disease, all renal parenchyma are involved by some sort of pathology, and the surgeon is faced with the challenge of excising all diseased tissue while still retaining renal function. A recent study evaluated the use of renal-sparing surgery as a means of solving just such a dilemma. In this study, Campbell and associates evaluated 34 patients with coexistent RCC and renal artery disease in the form of 1 of the scenarios

Main Points

- Increasingly, small, low-stage RCC lesions are diagnosed incidentally, because of the improved sensitivity of CT and ultrasound.
- The most common complications of partial nephrectomies performed in the last 10 to 12 years are hemorrhage, urinary fistula, increased creatinine, and myocardial infarction.
- Five-year cancer-specific survival rates for patients with local RCC range from 84% to 100%, particularly for patients with T1 lesions.
- Nephron-sparing surgery can be effective for patients with coexisting RCC and renal artery disease.
- The cutoff tumor size for the successful use of partial nephrectomy is 4 cm.

When used to treat patients with T1 RCC, partial nephrectomy resulted in survival rates (100%) that were not significantly different than those obtained with radical nephrectomy (97.5%).

Table 3.
TNM Classification of Renal Cell Carcinoma According to the AJCC Classification

	AJCC 1987		AJCC 1997
T1	Tumor ≤2.5 cm in greatest dimension, limited to the kidney		Tumor ≤7.0 cm in greatest dimension, limited to the kidney
T2	Tumor >2.5 cm in greatest dimension, limited to the kidney		Tumor >7.0 cm in greatest dimension, limited to the kidney
T3	Tumor extends into major veins, or invades adrenal or perinephric tissues but not beyond Gerota's fascia		Tumor extends into major veins, or invades adrenal or perinephric tissues but not beyond Gerota's fascia
T3a	Tumor invades adrenal gland or perinephric tissues but not beyond Gerota's fascia	T3a	Tumor invades adrenal gland or perinephric tissues but not beyond Gerota's fascia
T3b	Tumor grossly extends into renal vein(s) or vena cava	T3b	Tumor grossly extends into renal vein(s) or vena cava below the diaphragm
		T3c	Tumor grossly extends into vena cava above the diaphragm
T4	Tumor invades beyond Gerota's fascia		Tumor invades beyond Gerota's fascia
N0	No regional lymph node metastasis		No regional lymph node metastasis
N1	Metastasis in 1 lymph node ≤2 cm		Metastasis to a single lymph node
N2	Metastasis in 1 lymph node >2 cm but not >5 cm in greatest dimension, or multiple lymph nodes, none >5 cm in greatest dimension		Metastasis in more than one regional lymph node
N3	Metastasis in a lymph node >5 cm in greatest dimension		
M0	No distant metastasis		No distant metastasis
M1	Distant metastasis		Distant metastasis

above.[26] Thirty of these patients underwent nephron-sparing surgery, and 8 patients underwent simultaneous partial or radical nephrectomy and renal revascularization. The study demonstrated preservation of renal function in 33 of 34 patients, with only 1 patient requiring chronic dialysis. The study also yielded a 68% survival rate (after 44 months of follow-up) for these patients while resulting in death secondary to metastasis in 9% of patients and survival with recurrence of RCC in 6% of patients. Hence, Campbell demonstrated that nephron-sparing surgery can provide an effective means of treating patients with coexisting RCC and renal artery disease affecting all functioning renal parenchyma. However, treatment must be individualized according to several factors, including the size of the tumor, the feasibility of nephron-sparing surgery, the type and severity of renal artery disease, the level of renal function, and the general medical condition of the patient.

Nephron-Sparing Surgery for Advanced RCC Partial nephrectomy has also been investigated in treating patients with locally extensive and metastatic RCC. In this setting, nephron-sparing surgery has not been a definitive therapy but rather an adjunct to immunotherapy or excision of metastasis to achieve locoregional control of the tumor. Angermier and associates (1990) evaluated the use of partial nephrectomy in 9 patients with venous involvement of RCC in a solitary functioning kidney.[27] The study found disease-free survival in 5 patients and death from metastasis in 4 patients, suggesting an increased incidence of tumor recurrence following partial nephrectomy as a treatment for local RCC with venous involvement. In contrast, a recent study by Krishnamurthi and colleagues[28] (1996) evaluated 15 patients with metastatic RCC who underwent partial nephrectomy and resection of all metastases. The study found that 6 of 9 patients who

underwent previous contralateral nephrectomy and 4 of 6 patients with a solitary kidney undergoing partial nephrectomy and resection of metastases enjoyed disease-free survival for mean follow-up periods of 31.3 months and 16.8 months, respectively. The authors of this study concluded that partial nephrectomy may serve as an effective treatment for patients with advanced RCC under certain indications.

Our experience demonstrated similar effectiveness of the adjunctive use of partial nephrectomy in advanced stage RCC. Seven patients with advanced stage (1 patient with T3a, 5 patients with T3b, and 1 patient with T4) RCC were followed for a period of 9 to 92 months (mean, 28 months) postoperatively. We demonstrated an overall survival rate of 57.2% and a cancer-specific death rate of 71.4%. Hence, while obviously not nearly as effective as in cases of low-stage RCC, nephron-sparing surgery may be of some utility as an adjunct in the treatment of patients with advanced stage RCC in situations where renal parenchyma must be preserved. Further studies are needed to evaluate the local renal recurrence rates and extent of renal function during systemic immunotherapy yielded by partial nephrectomy for these patients with advanced disease.

Nephron-Sparing Surgery for RCC in Von Hippel-Lindau Disease Von Hippel-Lindau disease (VHLD) is an autosomal dominant condition characterized by hemangiomas of the central nervous system, retinal angiomas, pheochromocytomas, epididymal cystadenomas, and pancreatic and renal cysts and carcinomas.[29-31]

Approximately 45% of patients with this condition experience RCC that is often diagnosed in young people and presents as multiple bilateral renal tumors.[30] While the RCC found in VHLD is typically low stage, it can progress to metastatic death and is a frequent cause of death for patients with this condition.[32] The RCC of VHLD is characterized by both solid masses as well as cysts either containing frank RCC or lined by hyperplastic cells representing incipient RCC.[33,34] The multicentric nature of RCC related to VHLD requires complete surgical excision of all solid and cystic renal masses.

Bilateral radical nephrectomy was first proposed as a means of surgically managing the bilateral, multifocal RCC associated with VHLD.[35] However, the need for chronic dialysis subsequent to such a procedure has made this option unattractive and led many to consider partial nephrectomy as a treatment option. While early studies demonstrated promising results with good long-term survival,[36] more recent studies have demonstrated a high recurrence rate in the remaining portions of the kidney.[37] A recent multicenter trial evaluating the use of nephron-sparing surgery for patients with RCC and VHLD yielded a 5- and 10-year survival rate of 100% and 81%, respectively.[38] This study also displayed a recurrence-free survival of these patients to be 71% at 5 years postoperatively but only 15% at 10 years postoperatively. Hence, while nephron-sparing surgery may serve as a good initial treatment for patients with RCC in the presence of VHLD, the high predilection for recurrence by RCC tumors in this syndrome mandates very close follow-up and the expectation that recurrence and reoperation will very likely be necessary.

Nephron-Sparing Surgery for Unilateral RCC With Normal Contralateral Kidney While nephron-sparing surgery has become an accepted method of treatment for patients with RCC in whom preservation of renal parenchyma is critical, radical nephrectomy has remained the mainstay of treatment

Table 4
Results of Nephron-Sparing Surgery for Renal Cell Carcinoma With a Normal Opposite Kidney

Reference	No. Patients	Disease-specific survival (%)	Follow-up (mean month)	Mean tumor size (cm)	Local tumor recurrence (%)
Bazeed et al[39]	23	100	35.8	3.3	0
Carini et al[40]	10	90	29.9	3.5	0
Brisset et al[41]	15	100	40	3	0
Morgan, Zincke[42]	20	100	45.6	3.1	0
Van Poppel et al[44]	21	95	41.2	3.2	0
Selli et al[45]	20	90	2-31	<3.5	0
Provet et al[46]	19	100	35	2.6	0
Steinbach et al[38]	61	90	36	3.2	3.3
Herr[47]	70	97	10 years	3	1.4
UCLA	63	100	53	3.47	1.6

Table 5
Survival of Patients With Stage T1 Unilateral Renal Carcinoma and Normal Opposite Kidney, Stratified by Tumor Size After Partial or Radical Nephrectomy

	Partial nephrectomy				Radical nephrectomy			
Size/cm	N	Tumor recurrence	Death	Months	N	Tumor recurrence	Death	Months
<2.5	15	0	0	44	12	0	0	31
2.5-4	38	1	0	51	40	1	1	45
4-7	10	1	0	64	27	1	1	35

N, number of patients; death, death of cancer; months, months of follow-up.

for patients with unilateral RCC and a normal contralateral kidney due to fears of local renal fossa recurrence and subsequent metastatic disease. However, as CT and ultrasound have become routine diagnostic procedures, the incidence of RCC discovered by chance has increased, creating a need to treat a great deal more small, low-stage RCC lesions localized to the kidney. The presence of such small, well-circumscribed lesions has led to a resurgence of interest in the use of nephron-sparing surgery for such RCC patients with a normal contralateral kidney. Several recent studies have demonstrated the efficacy of partial nephrectomy for such an indication, manifesting disease-free survival rates ranging from 90% to 100% (mean, 95%) and virtually no recurrence with a 3- to 5-year follow-up time (Table 4).[20,39-46] A recent study by Herr also demonstrated a 97% disease-free survival in patients with unilateral RCC and a contralateral kidney after a 10-year follow-up period.[47] A few recent studies also compared the survival rates for partial versus radical nephrectomy in treating patients with such small, solitary RCC lesions and found no significant difference in survival outcomes.[48,49] Of note, however, the mean tumor size of practically all of these studies was <3.5 cm, setting 4 cm as the benchmark tumor size, above which radical nephrectomy, rather than nephron-sparing surgery, should be performed. Nevertheless, these studies established nephron-sparing surgery as an acceptable treatment option for patients with small, solitary, unilateral RCC lesions with a normal contralateral kidney.

We recently expanded this criteria for utilizing nephron-sparing surgery in such patients. We retrospectively compared the results of 63 partial nephrectomies with those of 79 radical nephrectomies performed for patients with a unilateral RCC and a normal contralateral kidney between 1986 and 1997 (mean follow-up, 57 months). All patients studied had stage T1 TNM lesions under the new 1997 staging criteria and, thus, all RCC tumors were <7 cm in size. Comparison of these T1 lesions yielded no significant difference for patients treated with partial versus radical nephrectomy (P=.219). 100% survival was noted for patients treated with partial nephrectomy versus 97.5% survival for those treated with radical nephrectomy. No difference in survival was noted for lesions between 4 cm and 7 cm in size when compared with lesions measuring <4 cm in size (Table 5) (P=.18). In addition, the local recurrence rate for patients treated with partial nephrectomy (3%) was not significantly greater than that resulting from radical nephrectomy (2.4%). These data expand the findings of past studies, which established 4 cm as the cutoff tumor size for the successful use of partial nephrectomy. The data also serve to allay the predominant fears of recurrence preventing the more widespread use of partial nephrectomy and establish nephron-sparing surgery as a viable treatment option for patients with small (<7 cm), unilateral, solitary RCC lesions with a normal contralateral kidney.

Nephron-Sparing Surgery in Incidental RCC With the widespread use of ultrasound and CT as screening tools, the incidence of incidentally detected RCC lesions in asymptomatic patients has dramatically increased.[3,4] Discovered by chance, these lesions have been found to be smaller and lower stage than symptomatic RCC lesions at presentation.[50] Several studies have attempted to determine if the treatment outcomes for such incidental RCC lesions differ from those for patients with RCC presenting with typical symptoms such as hematuria, flank mass, flank pain, or systemic symptoms such as fever, chills, weight loss, or paraneoplastic syndromes. Evaluating treatment of these 2 different presentations of RCC with radical nephrectomy, these studies demonstrated a 30% to 60% difference in survival rates and a 15% versus 75% cancer-specific death rate for incidental versus symptomatic RCC, respectively.[51-53] A recent study by Licht and associates[54] also evaluated the outcomes of incidental ver-

sus symptomatic RCC in patients treated with partial nephrectomy. Like the previous studies, Licht found that incidental RCC lesions tended to be lower stage and smaller than those found in symptomatic patients. In addition, Licht demonstrated a significantly increased 5-year cancer-specific survival rate and decreased tumor recurrence rate in incidental versus symptomatic RCC lesions.

At our institution, we also examined the use of nephron-sparing surgery in treating both incidental and symptomatic RCC lesions. We found that symptomatic patients most often presented with flank pain, hematuria, and flank mass, in that order. Incidental tumors were found to be smaller in size (mean, 5.1 cm) than symptomatic lesions (mean, 7.3 cm). We also noted the propensity for incidental RCC lesions to be low stage. Fifty-two of 54 cases of incidental RCC were staged T1 versus 2 out of 53 cases staged T1 for symptomatic RCC. However, we did not note a significant difference in cancer-specific survival rates in the 2 groups with incidental and symptomatic lesions resulting in survival rates of 96.3% and 92%, respectively. In addition, the 2 groups also manifested similar recurrence rates following partial nephrectomy with incidental lesions recurring in 1.9% of cases versus symptomatic lesions, which recurred in 3.8% of lesions. Hence, in our experience, while incidental RCC tends to be of lower stage at presentation, the survival and recurrence rates following partial nephrectomy do not appear to be better than those for symptomatic RCC lesions.

Multifocality and Nephron-Sparing Surgery The possibility of multifocal renal cell carcinoma has served as a significant argument against the widespread employment of nephron-sparing surgery. While a small, solitary nodule may be noted preoperatively so as to make the patient eligible for partial nephrectomy, other occult, smaller lesions may not be detected in other parts of the kidney, resulting in incomplete removal of the tumor burden via nephron-sparing surgery. Historically, a high incidence of multicentric renal cell carcinomas have been found in patients with VHLD, acquired renal cystic disease, and hereditary renal cell carcinoma.[55-57] Several studies have investigated multifocal tumors in the context of sporadic renal cell carcinoma and have found the incidence to range between 4 and 20%.[58-61] The largest study, conducted by Chen and associates, reported an incidence of 7% in 100 cases studied.[61] The possibility of multifocal tumors present beyond the borders of the proposed partial nephrectomy creates the need for comprehensive preoperative imaging with CT and ultrasound as well as the possible use of intraoperative ultrasound to identify occult, multifocal lesions not previously detected. Despite the potential risks posed by the possibility of multifocal tumors, as stated previously, our series demonstrated that nephron-sparing surgery results in recurrence rates no greater than those found after radical nephrectomy.

Follow-up After Nephron-Sparing Surgery for RCC Given the increased complexity of partial nephrectomy as well as the theoretically increased risk of recurrence, close follow-up is crucial. A recent study establishing guidelines for postoperative follow-up after partial nephrectomy recommended yearly medical history, physical exam, liver and renal function studies, as well as measurements of serum alkaline phosphatase and calcium for patients with T1 to T3 disease.[62] The authors of this study also recommended yearly chest radiographs for patients with T2 or T3 disease and abdominal CT every 2 years or 6 months for stage T2 and T3 lesions, respectively.[62] In addition, because patients with 1 kidney (or a part of 1 kidney) following partial nephrectomy are at risk for glomerular hyperfiltration with subsequent proteinuria, a 24-hour urine protein level is also recommended.[56-58,63] Patients noted to have proteinuria should be treated with a low protein diet and angiotensin-converting enzyme inhibitor.

Studies following patients with RCC after nephron-sparing surgery have found recurrence rates ranging between 4% and 12%.[18-21,62,64,65] A recent study by Hafez and colleagues demonstrated a recurrence rate of 11.6%, including a local tumor recurrence rate of 4% and a metastatic recurrence rate of 7.6%.[62] Hafez also found an increased rate of recurrence with increased tumor stage at presentation. Our experience confirms this finding. Of the 146 patients undergoing partial nephrectomy in our study population, 115 patients were stage T1 RCC; 18, stage T2 RCC; 12, stage T3 RCC; and 1, stage T3 RCC. After a median follow-up of 74 months (range, 10-160 months), we demonstrated an overall recurrence rate of 8.2%, with a local recurrence rate of 2.7% and a distant metastasis rate of 5.5%. In addition, we found the incidence of postoperative local tumor recurrence and metastatic disease according to initial stage to be: 0.9% and 0.9% for T1; 16.7% and 5.6% for T2; 0% and 33% for T3; and 0% and 100% for T4. Hence, our experience confirms the correlation between tumor recurrence rate and initial tumor stage, indicating the necessity of close follow-up after partial

Given the increased complexity of partial nephrectomy as well as the theoretically increased risk of recurrence, close follow-up is crucial.

nephrectomy, particularly for patients initially presenting with high-stage lesions □

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